# FAR-INFRARED OBSERVATIONS OF CIRCINUS AND NGC 4945 GALAXIES

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## I. INTRODUCTION

Circinus and NGC 4945 are two galaxies luminous in the infrared and are characterised by compact non thermal radio nuclei, deep silicate absorption features and unusually strong water vapour maser luminosities. Moorwood and Glass (1984) have observed these galaxies extensively in the 1-20 μm range. In the far-infrared, observations upto 100 μm are available from IRAS. In order to study the cool dust component of these galaxies, we have observed them at 150 μm using the TIFR 100 cm balloon-borne telescope. Here, we report our observations along with deconvolved maps at 50 and 100 μm obtained from the Chopped Photometric Channel (CPC) on board IRAS.

## II. OBSERVATIONS AND RESULTS

Circinus galaxy was observed in a balloon flight in March 1985 using a single band (120-300 μm) photometer. NGC 4945 was observed in Nov. 1988 using a two band photometer which simultaneously viewed the same sky field in two bands of 45-75 μm and 110-210 μm. The field of view and chopper throw were 2'.4 and 3'.6. Intensity maps were obtained by deconvolving the observed signals using an MEM procedure resulting in a spatial resolution of 1'.5 (see Ghosh et al. 1988 for details).

No positive flux was observed from Circinus; the 3 upper limit to F(150), the 150 μm flux density is 150 Jy. For NGC 4945, the deconvolved maps at effective wavelengths of 59 μm and 150 μm (for T=35K and $\varepsilon \propto \lambda^{-n}$, n=1) are shown in Fig. 1 a-b. The CPC data on these two galaxies were deconvolved using the point source profile of Ceres to get maps with a resolution of 1' at 50 and 100 um and these are shown in Fig. 1 c-f. It is clearly seen that while Circinus exhibits only central emission, NGC 4945 is characterised by a nuclear source and disc emission. The IRAS COADD data also show that Circinus has very little extended emission (W. Rice, private communication) while NGC 4945 is extended at all IRAS wavebands. From the CPC maps we determine the flux densities in the central region as well as the total by integrating upto meaningful contour levels and subtracting a uniform background.The photometric growth curves for the central sources are shown in Fig. 2.The flux densities for the central source and the total are summarised in Table 1. The CPC data are means of 5 maps for Circinus and of 2 maps for NGC 4945. IRAS data have been color corrected.

For NGC 4945 both our and CPC data show that the central source is more extended at 100 μm than at 50 μm. Due to high pick up noise in the 59 um channel, our signal to noise ratio is not high and we are likely to miss extended emission at 59 μm. However,the IRAS COADD data clearly indicate extended emission both at 50 and 100 μm. Brock et al (1988) found only a compact (20") nuclear source at 100 μm. Apparently they have missed the extended emission . Using the central 2' CPC data and taking the emissivity index n=1, the central source has T=39 K, while the extended emission (total-central) has T=33K. Using these values, we compute F(150) to be 400 Jy

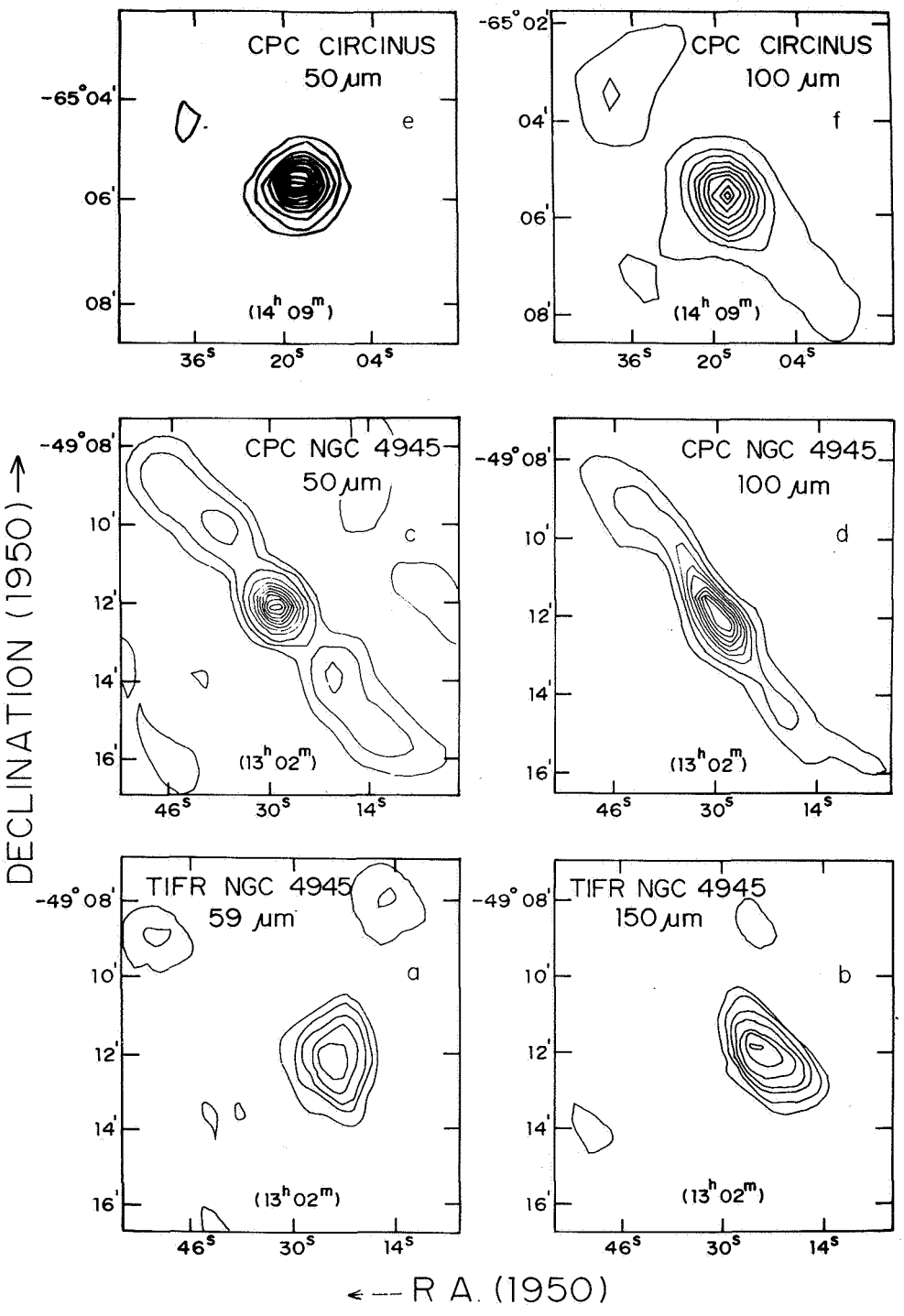


Fig.1. Deconvolved intensity maps of NGC 4945 and Circinus galaxies. The peak flux density (Jy) per pixel of 0.'3x 0.'3 are a) 4.1; b) 83. The contour levels are 95,70,50,30,20 and 10 percent of peak; for b) 5 % also. c-f are CPC maps. Peak flux density (Jy) per pixel of 20"x 20" are c) 25.9; d) 32.2; e)26.9; f) 21.Contour levels are 95,90,80,70,60,50,40,30,20,10 percent of peak. Also plotted for c) 5 and 2.5 percent and e) 5 percent.

and 550 Jy for the central and extended emissions and the total to be 950 Jy. Using a similar procedure, but using IRAS PSC and (total-PSC) fluxes we get total F(150) =1310 Jy. These can be compared with our observed total F(150)= 1605 Jy. Thus ,there seems to be more cool dust than that implied by IRAS data. For Circinus, the extended emission given by COADD data is < 20%. While from IRAS 60 and 100 μm data one gets T(60-100) = 43 K (n=1) and 35 K (n=2), using the 100 μm flux density and our 150 μm limit we get T(100-150) is >60 K (n=1) and >38 K (n=2).

**REFERENCES**


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Ghosh, S.K. et al, 1988, Ap.J., **330**, 928.
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Rice, W. et al, 1988, Ap.J. Suppl., **332**, 1093.


**Table 1**

| Galaxy | λ(μm) | IRAS FD(Jy) PSC | IRAS FD(Jy) Tot | CPC FD(Jy) 2'Dia. | CPC FD(Jy) Tot | TIFR FD(Jy) 3'Dia. | TIFR FD(Jy) Tot |
|---|---|---|---|---|---|---|---|
| Circinus | 50 | - | - | 157 | 157 | - | - |
| | 60 | 246 | 255 | - | - | - | - |
| | 100 | 323 | 381 | 244 | 300 | - | - |
| | 150 | - | - | - | - | <150 | - |
| NGC 4945 | 50 | - | - | 200 | 330 | - | - |
| | 59 | - | - | - | - | 103 | 110 |
| | 60 | 379 | 639 | - | - | - | - |
| | 100 | 684 | 1465 | 550 | 1170 | - | - |
| | 150 | - | - | - | - | 1465 | 1605 |

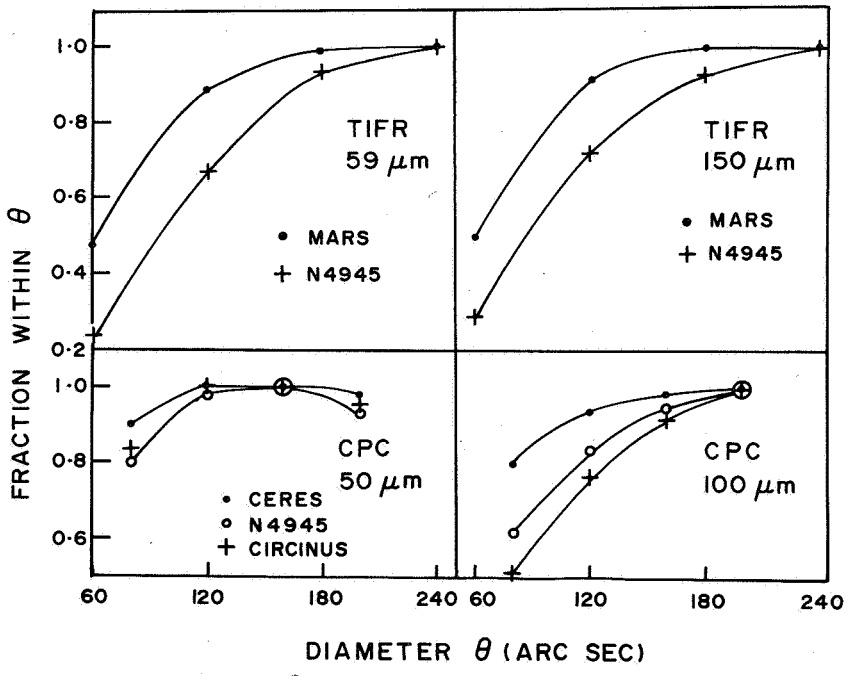


Fig. 2. Growth curves for the fraction of flux density within diameter θ . The decrease at large θ is due to background subtraction errors.